DOCUMENT RESUME

ED 295 655 IR 013 365

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TITLE A Comparison of the Effects of Locus of Control with Feedback Strategies on Factual Information Recall and Retention During Computer Assisted Instruction.
PUB DATE Jan 88
NOTE 19p.; In: Proceedings of Selected Research Papers presented at the Annual Meeting of the Association for Educational Communications and Technology (New Orleans, LA, January 14-19, 1988). For the complete proceedings, see IR 013 331.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Feedback; Hypothesis Testing; *Instructional Design; Intermode Differences; Junior High Schools; Junior High School Students; *Locus of Control; Multivariate Analysis; *Recall (Psychology); *Retention (Psychology)

ABSTRACT

This study investigated the effects of two factors on learner performance during computer-assisted instruction: locus of control, and varied feedback strategies. It was hypothesized that learners who attribute their successes and failures to internal events (Internals) will perform best under delayed feedback conditions, while those who attribute successes and failures to external events (Externals) will perform best given immediate feedback. In addition, it was hypothesized that there is significant interaction between feedback and locus of control. Junior high students from eighth and ninth grade classes were divided according to locus of control scores. Treatment consisted of giving immediate, delayed, or no feedback during computer assisted instruction to each group of students identified as having internal or external locus of control. Students were then tested for retention and recall. The results indicated that the Internals performed significantly better than the Externals on delayed feedback on the test for recall, but no other significant differences or interactions were found. The results of the data analyses are presented in four tables. (39 references) (Author/EW)

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A comparison of the effects of locus of control with feedback strategies on factual information recall and retention during computer assisted instruction

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IR013765

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Abstract

While the microcomputer has the potential of becoming a most effective teaching tool/aid, many studies reveal no significant differences in learning occurring due to instruction by microcomputer. It is believed that the design of current instructional software fails to accommodate major individual differences in learning styles. Locus of control (LOC) and its effect on learner performance during computer assisted instruction (CAI) given varied feedback strategies are investigated in this study. It is hypothesized that learners who attribute their failures and success to internal events (Internals) will perform best under delayed feedback conditions while those who attribute successes and failures to external events (Externals) will perform best given immediate feedback. In addition, it is hypothesized that there is significant interaction of feedback on LOC.

Junior high school students from three 8th and 9th grade classes were given the Intellectual Achievement Responsibility Questionnaire to determine LOC. Treatment consisted of giving immediate, delayed and no feedback during CAI to each group of students identified as having internal or external LOC. Tests for recall and retention were administered.

A t-test compared the means of performance scores (independent variable) on tests for recall (T1) and retention (T2) between the treatment groups (dependent variable); Immediate (IFB), Delayed (DFB) and No-feedback (NFB), for 2 LOC groups (dependent variable); Internal and External. A 2x3 multivariate analysis of variance (MANOVA) tested for significance of interaction between the three feedback conditions and LOC. The results indicated the Internals performed significantly better than the Externals on DFB on the test for recall. No other significant differences or interaction were found.

A comparison of the effects of locus of control with feedback strategies on factual information recall and retention during computer assisted instruction

Introduction

Of all of the recent innovations in education, the microcomputer possesses those attributes which most closely resemble the human instructor. One of the most exciting features offered by this technology is its capability of interacting with the learner. The learner is no longer passive, but active. Moreover, the microcomputer can present information, ask questions, enable the student to respond, give feedback, correct errors and it can even remember names.

Most often cited as a great advantage of the microcomputer is its ability to give immediate feedback. The assumption appears to be that giving immediate feedback is critical in learning. However, while the behaviorists fully support the immediate feedback/reinforcement theory of learning, many studies argue that delayed feedback or no feedback may be more effective feedback strategies.

As important as strategies are, however, studies show that unless the learner is motivated learning will not occur. Motivation may be external and internal, however more specifically it is the learner's perception of the events that cause success or failure and the control he has over those events that seem to determine the amount of learning that occurs. Studies show that learners who feel responsible for their own successes and failures perform better given delayed feedback or no feedback while those who feel other persons and events are responsible for their successes and failures have been found to perform better given immediate feedback.

Background

In instructional design, assessing the learner is stressed (Heinich & Molenda, 1985; Kemp & Dayton, 1985; Locatis & Atkinson, 1984), however the underlying assumption in a majority of CAI programs available for use in the classroom today is that most learning is achieved through the use of small steps and immediate feedback (Nishikawa, 1987). Ploch (1986) places partial responsibility for this inconsistency upon the developers of software who are usually computer programmers and not educators.

Feedback strategies

Behaviorists claim immediate feedback/reinforcement to be appropriate for all instruction (Skinner, 1954). Others (Waldrop, Justen & Adams, 1986; Kulhavy, 1977; Surber & Anderson, 1975; Sassenrath, 1975; Sassenrath and Yonge, 1968, 1969) argue that delayed feedback may be as effective and more efficient than immediate feedback . Moreover, Karraker (1967) and Lublin (1965) have found that with particular types of learners under certain

learning conditions, no feedback may be a more appropriate strategy. Kulhavy (1977) theorizes that "interference due to error perseveration is reduced if people are given a chance to forget incorrect responses" (p. 223) Studies determining the effectiveness of specific types and amount of feedback have produced mixed results (Merrill, 1987; Renzi, 1974; Block & Tierney, 1974; Tait, Hartley & Anderson, 1973). Annett (1969) attributes the difficulty of conducting such efforts to the transformations that have evolved over the past few decades in educational psychology particularly in feedback.

Skinner (1954) described feedback within a simple stimulus-response paradigm. However, feedback is now believed by some researchers (Powers, 1973) to be behavior in itself. Powers (1973) theorizes that "stimuli depend on responses according to the current organization of the environment and the body in which the nervous system resides" (p. 178) and that an individual knows nothing of his own behavior but the feedback effects of his own output. Therefore, according to Powers (1973), feedback is behavior.

Feedback and locus of control

Concurrent with Powers' position, Snow and Salomon (1968) maintain that learning variables within an individual function selectively and that an individual's development is a critical learning factor. Bar-Tal and Bar-Zohar (1977) in their review of 36 studies on the relationship of perception of control and achievement report a firm trend suggesting that for persons attributing failures and successes to self achievement was higher. When Baron and Ganz (1972) and associates (Baron, Cowan, Ganz & MacDonald, 1972) studied various feedback strategies using academic achievement as a dependent variable, significant differences were found between those identified as attributing the consequences of their behavior on external events (Externals) and those who accepted the responsibility for their successes and failures (Internals). It is suggested that by early adolescence the effect of intrinsic and extrinsic feedback is generally governed by variations in locus of control (LOC). Louie, Luick and Louie (1985-86) also contend that these perceptions will vary from person to person and within an individual over time.

Feedback and CAI

More recently educational research has attempted to determine the effectiveness of the microcomputer used in the instructional environment. Some researchers (Tait et al, 1973; Cohen, 1985; Albertson, 1986) claim instructional design of CAI generally inferior as reliance is placed on outmoded theories and practice. Carrier (1985) emphasizes that educators must take advantage of the microcomputer's ability to collect data, respond appropriately, diagnose needs, prescribe instruction, simulate activities and evaluate sequences among other characteristics to meet individual learning needs.

The study of feedback strategies in instruction by microcomputer is still in its infancy. In one study, Cohen (1985) discovered that the greatest effect on performance resulted from

information feedback given after incorrect responses. Feedback after correct responses was reportedly unimportant to students in certain cases. Cohen (1981) posits that feedback after a correct response may cause interference in learning, particularly with those students who maintain high confidence in their knowledge of the material. Immediate feedback seemed most effective only in knowledge acquisition for those students having difficulty mastering the material.

In a later study, Waldrop, Justen and Adams (1986) varied the amount of corrective feedback during drill and practice in CAI and found that immediate extended feedback following both correct and incorrect responses is superior to minimal feedback or simply acknowledging right or wrong responses. On the other hand delayed feedback in CAI was found to be significantly better than immediate feedback in a study by Rankin and Trepper (1978).

Locus of control and CAI

Cohen (1985) alludes to a relationship between high confidence in the knowledge of the material to be learned and the need for feedback. Students having difficulty mastering the material seemed to perform better given immediate feedback.

Louie et al. (1985-86) studied 46 students, 9 to 15 years of age, of high socioeconomic status to determine whether by using Logo and Bank Street Writer there would be a shift in LOC. While the results are questionable, significant shifts were found in LOC. In a study by Wesley et al. (1985), however, no main effects and no interaction of LOC and acquisition of science process skills during CAI.

As the use of microcomputers increases, concepts such as reinforcement, feedback and LOC need to be more clearly defined Louie et al. (1985-86) states that "if locus of control does play a significant part in the child's interpretation of reinforcement and its relationship to events occurring in reality, then software design should be influenced in the light of such research findings" (p.107).

The need for feedback in CAI studies is strongly urged by Gilman (1969) and others (Cohen, 1985; Hedberg and McNamara, ; Merrill, 1983, 1987). Furthermore, Merrill (1987) and Cohen (1985) express the need for better and more efficient CAI.

The new technology demands that developers of instruction integrate current research findings related to cognition and instruction (Costa, 1980) into instructional design of CAI. With the high potential the microcomputer holds as a teaching/learning tool expanded by the ease of current assuring systems, the possibility of designing diverse instruction to meet specific individual needs is now possible.

The study

Purpose

This study was designed to examine the effects of immediate, delayed and no feedback conditions on recall and retention in a computer based instruction and to determine whether an individual's LOC significantly interacts to affect performance.

It was hypothesized that:

1. Given immediate feedback, the Externals (learners identified as having external LOC) will perform significantly better than the Internals (learners identified as having internal LOC) on the tests for recall and retention.
2. Given delayed feedback, the Internals will perform significantly better than Externals on the tests for recall and retention.
3. Given no feedback, the Internals will perform significantly better than Externals on the tests for recall and retention.
4. Significant interaction will be found between LOC measures and the feedback conditions.

Location

The study was conducted at a junior high school in a midwestern, suburban community of approximately 60,000. The school serves a middle to upper middle social-economic population.

Subjects

Subjects were 37 students in two 9th grade and one 8th grade Social Studies classes, 23 males and 14 females.

Microcomputers

Twelve Apple II and IIe microcomputers in the school's Microcomputer lab were used in the study. The arrangement of the equipment permitted students to work independently.

Questionnaire

The Intellectual Achievement Responsibility Questionnaire (IARQ) developed by Crandall, Katkovsky and Crandall (1965) was used to measure students' beliefs that failures and successes in achievement are caused by internal or external factors. The instrument has acceptable reliability, both divergent and convergent validity (MacDonald, 1973) and contains 34 forced-choice items. A total of 24 or less identified the students as having external LOC and 26 or more, internal LOC.

Computer assisted instruction (CAI)

The same instructional sequence was presented under three different conditions: immediate, delayed and no feedback. The lessons were created using Super-Pilot, an Apple authoring software package. In order that the instruction could be easily completed during one 50-minute period, each program consisted of 28 frames taking about 20 minutes.

Immediate feedback condition

The CAI program presented text and graphics. At the

end of each step, the student responded to a question relative to the information, was given praise/acknowledgment of correctness/incorrectness of answer, was remediated if incorrect, then instructed to continue.

Delayed feedback condition

The CAI program presented identical text and graphics. The student was informed in the introduction to the lesson that responses to questions would not be acknowledged at the end of each step but would be delayed until the end of the lesson. Therefore, at the end of each step, the student responded to a question relative to the information but was not given feedback before being instructed to continue.

No-feedback condition

The CAI program presented identical text and graphics. The student was informed in the introduction to the lesson that responses to questions would not be acknowledged. At the end of each step the student was given the option to respond or not respond then instructed to continue.

Immediate test for recall

A 15-item paper and pencil test was given immediately after the CAI instruction.

One week test for retention

A similar 15-item paper and pencil test was given a week after the CAI instruction.

Experimental schedule

The IARQ was administered one week prior to the CAI testing. Students were divided into two LOC groups according to scores on the IARQ with Internals scoring 26 and above and Externals scoring 24 and less on a scale from 1-34. Each LOC group was further subdivided into three treatment groups, IFB, DFB and NFB.

On the day of the instruction, students received individual lesson diskettes identified by previously assigned identification numbers before proceeding to the microcomputers. Since there was general familiarity with the use of the equipment, students were asked to "boot" the program by simply inserting the diskette into the disk drive and turning on the power switch. Each of the programs directed the students to raise their hands upon completion of the instruction to signify readiness for the test for recall.

Once the test was completed, the students returned to the classroom. Two days following the instruction each student received the results of the test and corrective information to those items missed on the test. Seven days following the initial test, a paper and pencil test for retention was administered. Confidentiality was preserved by teacher assigned identification numbers.

Analysis of data

Performance scores on the tests for recall (T1) and retention (T2) and locus of control, Internal and External, were the dependent measures. The treatment, consisting of of immediate (IFB), delayed (DFB) and no-feedback (NFB) conditions, was the independent measure. t-tests were performed to detect the presence of significant differences between the means of the treatment groups for the Internal and External measures. The 2x3 multivariate analysis of variance (MANOVA) was used to test for interaction between LOC and feedback.

Results

The summary of cell means and standard deviations for the variables are presented in Table 1. The test for recall (T1) and retention (T2) were scored on the basis of number of correct answers out of a possible maximum of 15 items for each test. Locus of control was determined by scores on the IARQ with Internals scoring 26 and more and Externals scoring 24 and less on a scale from 1-34.

Insert Table 1 here

Hypothesis 1. Given immediate feedback, the Externals will perform significantly better than Internals on tests for recall and retention during CAI.

The t-test used to compare the means of performance scores of the IFB condition on the Internals and Externals indicated no significant difference on T1, $t(11)=-0.11$, or T2, $t(8)=-0.71$.

Insert Table 2 here

Hypothesis 2. Given delayed feedback, the Internals will perform significantly better than Externals on tests for recall and retention during CAI.

The t-tests used to compare the means of performance scores of the DFB condition on the Internals and Externals indicated a significant difference in performance for T1, $t(12)=1.90$, $p<.04$. No significant difference was noted in T2, $t(12)=1.56$ (Table 2)

Hypothesis 3. Given no feedback, the Internals will perform significantly better than the Externals on tests for recall and retention.

The t-test used to compare the means of performance scores of the NFB condition on the Internals and Externals indicated no significant difference on T1, $t(11)=0.08$, or on T2, $t(11)=-1.64$ (Table 2).

Hypothesis 4. Significant interaction will be found between LOC measures and feedback conditions.

Neither the test on the univariate (Table 3) nor the MANOVA using Wilk's test of significance (Table 4) indicates the presence of any interaction between LOC and feedback conditions.

Discussion

The results of the t-tests performed on the treatment variables provide no support of the hypotheses that immediate feedback or no-feedback are more effective conditions or that they are better instructional strategies for either Internal or External LOC learners. However, the significant difference found between the performance of Internals and Externals under DFB conditions ($p=<.04$) indicates LOC learners would be more likely to show better performance under delayed feedback conditions than from either immediate or no feedback conditions.

In earlier LOC by academic achievement studies, Crandall and Battle (1970), Baron and Ganz (1974) and Bar-Tal and Bal-Zohar (1977), have found that high achievers are generally Internals. In addition feedback studies show delayed feedback to be more effective for certain individuals (Kulhavy, 1977; Rankin & Trepper, 1978).

If, indeed, the data support the hypothesis that given delayed feedback Internals will perform better than Externals, it could provide some insight into the type of individual who benefits from delayed feedback. Kulhavy's (1977) "interference due to error perseveration" phenomenon (p. 223) could well be a characteristic of the cognitive process experienced by the Internal.

Drawing conclusions regarding achievement and locus of control from this study or any study must be done cautiously (Stipek, 1980), however. It is the contention of researchers that in addition to flaws in research design and procedure there are other variables such as socioeconomic conditions (Crandall, Katkovsky & Crandall, 1965), race (Baron et al., 1974), and sex (Louie et al., 1985-86) which operate to confound any set of data.

While comparable results are described in other studies in feedback strategies in instruction and the effect of locus of control in academic achievement (Beck & Lindsey, 1979; Kulhavy, White, Topp, Chan & Adams, 1985; Bar-Tal & Bar Zohar, 1977) major limitations contributed to the contamination of the present study.

1. Small sample size

A larger sample would indeed have increased the power of the study. Keppel (1982) suggests that a 2x3 factorial design have at least 20 subjects per cell. Although contact was made with 79 students in this study, only 37 completed all phases of the study. Absences and inattentiveness were primary causes of attrition.

2. Limited instructional time

Permission to conduct the study in a junior high school classroom was obtained contingent upon an agreement that the IARQ, the lesson, and tests for recall and retention take no longer than 70 minutes on three given days, 10 minutes for the IARQ, 50 minutes

for instruction and 10 minutes for the retention test. Instruction over a longer period of time would have produced more significant data.

3. Short CAI program

In order that the students spend no more than 50 minutes in the microcomputer lab, it was necessary to limit the CAI program to 28 frames which took approximately 20 minutes for the students to complete. The narrow range of performance values did not provide an accurate profile of knowledge acquisition or retention.

4. Instruction not a part of the classroom curriculum

The awareness that the lesson would not affect students' grades appeared to have impact on attitude toward the instruction. Obvious signs of relief were observed when students were told the tests would not be graded.

Conclusions

In spite of the four limitations cited, two conclusions are made. The first relates to the hypotheses and the second to experimental design.

The data indicates a need for further research on the effectiveness of delayed feedback for internal LOC learners. Out of the four hypotheses presented, the results showed support only for the delayed feedback as an effective strategy for learners who are identified as Internals.

From this study it is concluded that in conducting research of this nature, it would be valuable for researchers to be aware of the processes involved in obtaining data from school children and the yield from such studies. It should be noted that seven levels of approval had to be met before experimentation could begin and that the attrition rate was 53% which yielded 37 usable data. Information of this sort is just as necessary in interpreting the results of studies such as this as are statistical data.

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Table 1

Summary of cell means and standard deviations of Immediate (IFB), Delayed (DFB) and No-feedback (NFB) treatment groups on LOC groups

TEST FOR RECALL (T1)

LOC	Treatmt	Mean	S.D.	N	95% Conf.	Interval
Internal	IFB	12.714	2.360	7	10.531	14.897
	DFB	13.556	1.424	9	12.461	14.650
	NFB	12.429	2.070	7	10.514	14.343
External	IFB	12.667	1.528	3	8.872	16.416
	DFB	11.200	3.271	5	7.138	15.262
	NFB	12.333	2.503	6	9.706	14.960
Entire Sample		12.595	2.192	37	11.864	13.325

TEST FOR RETENTION (T2)

LOC	Treatmt	Mean	S.D.	N	95% Conf.	Interval
Internal	IFB	8.429	2.225	7	6.370	10.487
	DFB	10.667	1.581	9	9.451	11.882
	NFB	7.857	1.676	7	6.307	9.407
External	IFB	9.667	3.215	3	1.681	17.652
	DFB	9.000	2.449	5	5.959	12.041
	NFB	9.833	2.639	6	7.063	12.603
Entire Sample		9.270	2.269	37	8.514	10.027

Table 2

Summary of cell means, standard deviations and t-test of IFB, DFB and NFB on Internal and External LOC

TEST FOR RECALL (T1)

Immediate

LOC	N	Mean	S.D.	t-Value	df
Internal	7	12.714	2.360	-0.11	11
External	3	12.667	1.528		
Total	10	12.700			
Mean Difference		0.047			

Delayed

LOC	N	Mean	S.D.	t-Value	df
Internal	9	13.556	1.424	-1.90*	12
External	5	11.200	3.271		
Total	14	12.715			
Mean Difference		2.356			

No-feedback

LOC	N	Mean	S.D.	t-Value	df
Internal	7	12.429	2.070	0.08	11
External	6	12.333	2.503		
Total	13	12.384			
Mean Difference		0.096			

TEST FOR RETENTION (T2)

Immediate

LOC	N	Mean	S.D.	t-Value	df
Internal	7	8.429	2.225	-0.71	8
External	3	9.667	3.215		
Total	10	8.800			
Mean Difference		1.238			

Delayed

LOC	N	Mean	S.D.	t-Value	df
Internal	9	10.667	1.581	1.56	12
External	5	9.000	2.419		
Total	14	10.072			
Mean Difference		1.667			

No-Feedback

LOC	N	Mean	S.D.	t-Value	df
Internal	7	7.857	1.676	-1.64	11
External	6	9.833	2.639		
Total	13	8.769			
Mean Difference		1.976			

Table 3

Test of significance of interaction between Internal and External LOC and treatment conditions on the univariate

TEST FOR RECALL (T1)

Factor	df	SS	MS	F	Signif. of F
LOC	1	5.691	5.691	1.144	.293
Treatment	2	.613	.307	.062	.940
LOC x Treatment	2	10.418	5.209	1.047	.363

TEST FOR RETENTION (T2)

Factor	df	SS	MS	F	Signif. of F
LOC	1	2.184	2.184	.463	.501
Treatment	2	6.827	3.413	.724	.493
LOC x Treatment	2	23.225	11.612	2.464	.102

Table 4
Wilk's multivariate test of significance for LOC, Treatment and LOC x Treatment

Factor	Value	df	F	Signif. of F
LOC	.889	2	1.873	.171
Treatment	.920	4	.637	.645
LOC x Treatment	.859	4	1.181	.328